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THE FOREST RESOURCES OF THE MACKENZIE DELTA

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ARCTIC CIRCLE TIMBER

One readily associates Newfoundland with fisheries, Saskatchewan with wheat and Alberta with beef and oil. But how many people would associate, even remotely, the Mackenzie Delta of the Northwest Territories with timber and forest products? Many would no doubt quote the traditional activities of hunting, fishing and trapping while the more informed would refer to the current search for minerals, oil and gas. But forestry in the Mackenzie Delta? Surely this is not possible! After all, we are talking about a land as far north as the centre of Baffin Island and closer to the Pole than any portion of Hudson Bay.

Many people, of course, tend to associate climatic conditions solely with latitude, without realizing that the effects of ocean currents and mountain ranges can, to a large extent, overpower those parallel lines drawn across the face of a map.

Why then does forest growth extend well into the Mackenzie Delta, while the southern end of Hudson Bay is treeless? The reason is largely related to climatic conditions. Very generally speaking, trees will not grow where the average temperature of the warmest month of the year is less than 50°F. The northern limit of tree growth, therefore, co-incides very closely with the isotherm tracing the mean July temperature of 50°. In other words, the climate at Inuvik (Latitude 68° 22'N), on the east side of the Mackenzie Delta, is no more severe than it is at Moosonee on the southern end of James Bay, 1,200 miles further south.

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SPECIFIC AREA OF DISCUSSION

In order to include all timber which might be managed from the Inuvik-Aklavik region, the Mackenzie Delta has been expanded, so to speak, for the purposes of this report. This discussion of forestry will therefore include, in addition to the Delta itself, timber stands along the Mackenzie River north of Fort Good Hope, the Lower Arctic Red River and the portion of the Peel River north of the Yukon - Northwest Territories boundary.

THE NATURE AND PREDOMINANT CHARACTERISTICS OF THE FOREST

1. Upstream Forests

The lower Mackenzie River and its tributaries flow through well defined valleys carved into the northern extension of the interior plains of Canada. As these waters weave their way to the sea, their load of sediment is deposited to form rich alluvial benches, islands and levees of fine sandy silt along the waterways.

With the exception of the northern portion of the Delta, which lies within the tundra, the area falls within the Boreal Forest Region. Typical tree species are white and black spruce, popular, white birch and tamarack with alder and willow.

The only species which attains sawlog size, however, is white spruce. Along the rivers south of the Delta, the spruce attains suitable dimensions only on the alluvial benches and islands, where infrequent but periodic flooding occurs. Individual stand volumes vary from a few hundred thousand to several million board feet of timber. Because these merchantable stands are restricted to the river valley, seldom do they extend more than two miles from a navigable waterway; the majority of the timber lies within one mile of the river bank. Individual trees 30 inches in diameter and 100 feet in height are not uncommon, but the typical stand averages 70 to 80 feet in height with a maximum DBH

of 16 to 18 inches, is 250 years of age and yields an average of eight to ten thousand board feet per acre.

Most of these stands create an impression of great uniformity and exhibit an even-aged, almost plantation-like appearance. In actual fact, however, the ages of individual trees may vary by as much as 200 years.

The high, steep banks along the rivers support primarily scrub spruce and white birch. Occasionally, where the surrounding topography affords protection from the wind, spruce up to 40 or 50 feet in height will occur. The flat plains above the river banks, subjected to the rigors of climate and forest fires, exhibit patches of scrub spruce, muskeg and tundra interspersed between the many small lakes.

2. Forests of the Delta Proper

The Delta forests produce a somewhat different picture, although the conditions affecting growth are similar. A person travelling one of the Delta channels might believe he is passing through an endless forest since spruce trees line most of the higher banks. An air traveller, however, realizes that the forests are predominantly narrow strips along the levees of the channels with the majority of the Delta consisting of willows, alders, sedges and a multitude of lakes. The percentage of the Delta supporting spruce gradually diminishes from a maximum of 40 percent immediately north of Point Separation until the limit of growth is reached in the vicinity of latitude 68° to 45'N.

The typical spruce stands of the Delta average between 100 and 300 years of age but trees in excess of 500 years have been reported. Here, as in other northern areas, the Delta spruce exhibits the longevity typical of trees at their northern limit of growth.

The Mackenzie Forest Service recently located a permanent sample plot in a white spruce stand on the East Channel of the Delta midway between Inuvik and

Reindeer Station, within 25 miles of the limit of spruce growth. This plot indicates 480 trees per acre from 3 to 13 inches DBH, with a basal area and gross volume of 252 square feet and 3,300 cubic feet per acre respectively.

The general appearance of Delta spruce is that of uneven-aged forests. The stands exhibit a patchy appearance due to variations in diameter and stocking, particularly in the southern portion of the Delta where the spruce cover is more complete. Very generally speaking, trees 8 inches in diameter will be 75 years of age; 12 inches in diameter, 200 years; and 15 inches in diameter, 250 years or older.

3. Flooding, Permafrost and Vegetative Layers:

Throughout the lower Mackenzie Valley, the permafrost table during the summer is rarely more than 15 inches below the surface. Therefore, all plant growth must rely on an active layer which varies from a few inches to one and one-half feet. Vegetation along the water-ways is extremely responsive to flood conditions and fluctuations in the level of permafrost. The altitude at which a particular vegetation type appears on opposite river banks usually agrees within a vertical limit of several inches.

Typically, after the water level drops following spring break-up, the exposed river or channel banks adjacent to the water become green with a fresh growth of grasses, sedges and horsetails. Alders grow just above the annual flood level with poplars, if present, situated above the alders but below the spruce which occupies the highest ground. The most northerly limit of spruce is associated with a levee height of about 10 feet above sea level, whereas in the southern portion of the Delta and upstream the spruce is situated on levees or flats 20 to 30 feet above the late summer low-water level.

Most, if not all, of the spruce sites are subject to periodic flooding. This is evident in many places by the highwater mark on tree trunks with soil stocked stand or predicted value of the trend of aspen growth. This gives [illegible] with a basal area and gross volume of 105 square feet and 2,755 cubic feet per acre respectively.

The general appearance of these aspen is that of [illegible] stands. The stands exhibit a patchy appearance due to variations in diameter and stocking, particularly in the southern portion of the stand where the spruce cover is more complete. [illegible] trees 8 inches in diameter with an [illegible] of up to 11 inches in diameter, 100 years and 15 inches in diameter, 110 years or older.

2. Flood [illegible]

Throughout the lower reaches of [illegible] Valley, the predominant feature during the summer is [illegible] the surface. Therefore, all plant [illegible] a few inches to one and one-half feet. [illegible] is extremely responsive to flood conditions and the duration of the period of growth. The [illegible] rivers, banks usually covered with a [illegible] of [illegible] growth.

Generally, after the water level drops following spring break-up, the exposed areas of channel banks adjacent to the water become green with a fresh growth of grasses, sedges and horsetails. Alders grow just above the annual flood level with poplars, if present, situated above the alders but below the spruce which occupies the highest ground. The most noteworthy lack of spruce [illegible], whereas in [illegible] layer of [illegible].

Where [illegible]

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and small debris lodged in the lower branches. As successive alluvial deposits build up or the insulating layer of organic material over the mineral soil becomes thicker, the permafrost level rises accordingly. Provided that such deposition does not occur too frequently or in excessively thick individual layers, the established trees have the capacity to put forth additional roots into the newly formed upper soil layers. Gradually, a multi-layered root system may develop with the upper layers in the active soil zone and the lower layers firmly frozen into the permafrost. No doubt this at least partly explains why windfall rarely occurs in the spruce stands.

4. Diseases, Defects and General Quality

These northern forests have not escaped the attention of a variety of insects and diseases, although the extent and range of such infestation is as yet not too well defined. Various species of budworm have been observed on spruce from Fort Good Hope to the Delta and at least one species of leaf roller is present on deciduous trees and shrubs throughout the area.

Various needle casts, leaf rusts, heart rots and witches brooms are evident. Increment borings taken along the Arctic Red River indicate that approximately 40% of the trees 10 to 15 inches DBH contained butt rot, although this probably extends only 6 to 8 feet up the trunk.

Large burls or galls, similar to those which adorn sign posts in Banff and Jasper National Parks, are evident in specific locations. While the stands in general lack these adornments, in certain small patches almost every spruce tree will exhibit these growths.

Spiral grain is prevalent in the spruce, especially in the lower Delta. In certain trees this spiral may deviate 30° to 45° from the vertical axis of the stem.

In 1966, a sample of Mackenzie Delta white spruce was shipped to the

Forest Products Laboratory in Ottawa for testing. The tests indicated that Delta spruce is comparable in strength and elasticity with white spruce from the rest of Canada. Provided that the lumber is properly manufactured, seasoned and graded it provides suitable material for general construction purposes.

FOREST INVENTORY DATA

Most of the inventory data presently available for the Lower Mackenzie River and the Delta are of a very preliminary nature. The one exception is the Arctic Red River for which the Department of Forestry and Rural Development completed a detailed inventory in 1967.

According to the best information available, the area north of Fort Good Hope contains approximately 90,000 acres which supports 750 million board feet of sawlog size white spruce. This volume is comprised of an estimated 120 million feet on the Mackenzie River north of Fort Good Hope, 20 million feet on the lower 45 miles of the Arctic Red River, and 610 million feet in the Mackenzie Delta and the portion of the Peel River within the Northwest Territories. An additional 150,000 acres supports 140 million cubic feet of spruce between 20 and 50 feet in height.

PAST AND PRESENT FOREST UTILIZATION

Presumably the forests of the lower Mackenzie have been utilized in a very small way ever since human life first appeared on the scene. However, the volume used for dwellings, implements, transportation equipment and fuelwood before the arrival of the white man certainly must have barely scratched the surface. The early steam powered river boats which plied the Mackenzie and its tributaries used considerable quantities of fuelwood but such cutting was restricted primarily to hardwoods growing immediately adjacent to the rivers.

Many thousands of spruce piles were cut for construction of the new town of Inuvik. Most of the buildings and facilities in Inuvik are set on piles, which are firmly frozen into the permafrost, providing a layer of air which insulates the ground surface from the heat of the buildings. A large number of pilings will be required annually since this construction technique is now used throughout the area.

In 1960, the Federal Government began a logging and sawmilling project in the Delta as a winter works relief program. Logs were taken to Aklavik and later used for housing but little lumber was produced. A sawmill was operated at Aklavik as a vocational training program in 1961 and 1962.

In 1963, the Industrial Development Section of the Department of Indian Affairs and Northern Development took over the logging projects with a view to developing viable operations which would at the same time provide employment and produce a useful product. Initially, the annual appropriation of funds was divided among the four Delta settlements of Arctic Red River, Fort McPherson, Aklavik and Inuvik. Logging operations were conducted in the more accessible sawlog stands from January to March. The timber was skidded, often by dog team, to the river bank where rafts were formed and the timber floated downstream to the sawmills following spring breakup. Although it continued for three years, the program was hindered by extreme winter temperatures, a large number of small scattered logging sites, the difficulty of rafting logs on these northern rivers, inexperienced workers and the difficulty of providing adequate supervision, plus a host of other problems.

In 1966, the Industrial Division established a sawmill 37 miles up the Arctic Red River from its junction with the Mackenzie. After one year's operation, the mill was moved to a permanent site at the mouth of the river across from the settlement. The timber, logged as far as 45 miles upstream, is now transported

by winter truck haul or summer rafting to the millsite. Current production includes piling, rough and planed lumber, and dimenstion timbers. Recently, sawdust and edgings have found a market with oil companies conducting exploration activities throughout the Delta. The Industrial Division expects to turn this project over to private enterprise in the near future.

Total production to date,however, has been relatively small. Our records indicate that 3 million board feet of sawlogs, 1.6 million lineal feet of piling and building logs and 2,000 cords of fuelwood have been cut in the lower Mackenzie north of Fort Good Hope since 1956.

FUTURE POTENTIAL

Management of the forest resources of the lower Mackenzie Valley must consider four basic objectives:

1. Protection of the existing forest from fire, insects and disease.
2. The ability to harvest the present mature and over-mature stands.
3. The ability to maintain or, hopefully, to increase the present productivity of the forest.
4. Management of the total environment.

The Mackenzie Forest Service has been actively engaged in forest fire suppression since the late 1940's. Much of the total land area in the Mackenzie District is still unprotected; top priority within the protected zones is extended to areas of economic development and productive forest land. Forest insect and disease conditions are surveyed periodically by personnel of the Department of Forestry and Rural Development.

As previously stated, the forests north of Fort Good Hope contain an estimated 750 million board feet of mature and overmature sawlog size white spruce. The second management objective is therefore the utilization of these stands. These northern forests present a number of anomalies; experience gained

to date has raised a number of alternatives but has provided few conclusive answers.

Much of the timber is comprised of relatively small stands separated by several miles of unproductive forest. From a logistic standpoint, this would tend to favour a number of small logging units rather than one large operation, but this creates the problem of keeping overhead costs in line with production. Because of wet terrain, many of the stands cannot be logged during the summer months. Winter conditions, on the other hand, are such that the fibre of both the mechanical and human machine are tested to the utmost.

Should portable sawmills be moved from stand to stand, or should the timber be trucked or barged to permanent millsites situated in one or more of the Delta settlements? Certain arguments seem to favour each approach. The possibility of mounting a sawmill on a barge would be worth investigating.

Although most of the timber is within 200 miles of Inuvik, it is difficult to meet the price of timber shipped from southern Canada because of the high operating costs in the north. Although a large volume of timber is of sawlog size, it is probably not all of sawlog quality because of spiral grain, excessive branchiness and other defects. Would a small chip-board plant be a feasible development?

These and a host of other problems must be solved before the existing forests can be utilized to their full capacity. Although the market potential has not been fully explored, local demand presently exceeds local production. The evidence to date suggests that if local lumber can be well manufactured, seasoned and graded at a competitive price, suitable markets will not be lacking.

Assuming, then, that economic logging operations are or will be possible in the lower Mackenzie, the question arises whether or not these northern forests could be operated on a sustained yield basis. While present knowledge of the forest does not permit detailed computations, a few reasonable calculations

may indicate the future potential.

If we assume a rotation age of 200 years, the 90,000 acres of presently operable forest would permit an annual cutting area of 450 acres. If we further assume an average volume at rotation age of 8,000 to 9,000 board feet per acre, (the present yield) the allowable annual cut would be approximately 4 million board feet. If at least part of the additional 150,000 acres presently supporting smaller timber will produce merchantable stands, or if the yield of the better sites can be increased, or if the rotation age could be reduced, the allowable annual cut might conceivably be increased to 10 million board feet.

Fortunately, we can be optimistic that these forests may indeed be coaxed into greater productivity. Through personal conversation and correspondence and unpublished reports, Mr. J. M. Robinson of the Forest Management Institute of the Department of Forestry and Rural Development has presented a number of observations concerning the forests of Northern Canada. With the kind permission of Mr. Robinson, a number of his observations are summarized here:

(1) The establishment and maintenance of spruce stands on the alluvial flats appears to require periodic flooding. It is probably necessary to have a severe flood to provide a good seed bed followed by a good seed year, with no subsequent flooding until the seedlings have become established.

(2) Because decay of surface litter is very slow and bacterial action is limited in the cool northern climate, it is quite likely that most northern soils lack nutrients in available form.

(3) Despite the permafrost, trees will grow to sawtimber size provided that the soil is moss-free and there is little or no shade. The

permafrost provides moisture and the long days during the growing season keep the soil surface warm.

4) Rapid tree growth is possible even in the Mackenzie Delta. Mr. Robinson cites the example of a spruce tree at Point Separation which attained a height of 25 feet and a DBH of 3 inches in 22 years.

(5) Since development of a moss cover and dense shade results in a lowering of soil temperature and a rise in the level of the permafrost layer, in northern areas the forests must be very open to retain a rapid rate of growth.

(6) The key to northern forestry may be the establishment of mixed forests since hardwood litter may help prevent moss development and provide necessary nutrients to the soil.

(7) It is possible that much of the northern muskeg is not permanent waste but the climax forest type of the region. If this is so, it may be possible to convert certain areas of muskeg to productive forest. As the spruce cover becomes denser, with the development of an acid litter, mosses begin to grow under the trees. This reduces soil temperature, the spruce growth stagnates and as these trees die the area develops into a treed muskeg. Mr. Robinson postulates that forests in the Northern Boreal Region will inevitably degrade unless renewed by periodic flooding or fire. He also suggests that muskeg areas above flood level can be reclaimed and will support merchantable forests provided there is an increasing percentage of deciduous species where the climate becomes progressively colder.

Mr. Robinson's observations certainly point out the necessity of more ailed studies in the northern forests. At the same time, they indicate that practice of intensive forest management may be just as profitable here as

s in more southern climes.

To be more specific, "forest land management" is a much more appropriate . It is impossible to separate the trees from the environment in which are growing. Manipulation of the forests directly or indirectly affects life populations, recreational potential and the entire watershed. More more one hears the expression that unless foresters realize they are ging the total environment, and not just the trees, the time will soon ve when the forests will be too valuable to be left to the management of sters.

LUSIONS

Although the forests of the lower Mackenzie contain only a small percentage he estimated 23 billion cubic feet of merchantable timber in the Yukon Northwest Territories, they should in years to come provide an important ribution to the economy of north-western Canada. Their greatest asset may he fact that they are where they are, to provide a ready source of forest ucts required for all aspects of local development.

Unlike the Ottawa valley, for example, where logging opened up the country, North must rely on the underground resources to provide the initial impetus. northern forests, however, can provide a secondary industry which will to sustain the economy after the mines have come and gone.

OWLEDGEMENTS

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